Universal Leaf North America U.S., Inc.

NASH FACILITY
P.O. BOX 519
Nashville, NC 27856
Phone (252) 462-4300

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SOLID WASTE SECTION

Mr. Tony Gallagher
Solid Waste Section
NCDENR – DWM
217 Jones St.
1646 Mail Delivery Center
Raleigh, NC 27699-1646

Dear Mr. Gallagher;

Subject: NCDWM Annual Report for Universal Leaf North America Land Application Site, 2011 – 2012 processing season.

Please find attached our annual report as required by our land application permit. The report has been compiled with the help of Dr. A.R. Rubin. I hope you find all of the necessary information within the report. If you have any questions of comments, please feel free to reach me through the contact information below.

Best Regards,

John A. Sabatini

John A. Sabatini

Assistant Vice President, Engineering

Universal Leaf North America US, Inc.
3174 Boddie Mill Pond Road
PO Box 519
Nashville, NC 27549
(w) 252-462-4334
(e) sabatij1@universalleaf.com

Universal Leaf North America
2011-12 Annual Report
For
NCDWM Annual Report

Thank you for the opportunity to work with you and your colleagues on the ongoing beneficial reuse effort that has served as a viable dust management option permitted by the North Carolina Division of Waste Management (NCDWM) for the Universal Leaf North America (ULNA) Processing Facility near Nashville, NC. The land treatment operation continues to supply valuable nutrients to crops, successfully recycling valuable plant nutrients back into the plant – soil system. One element of the NCDWM permit requires annual testing.

The purpose of this ongoing testing is to ascertain consequences of the operation to soil and plant materials on the receiver sites. Testing indicates that the agribusiness wastes contain valuable levels of essential plant nutrients. Based on the soil and plant tissue testing accomplished, no adverse impacts were observed in plant or soil material and test results are within the ranges observed in North Carolina for the constituents assessed in the receiver environment.

With the exception of weed growth observed only in May and June, 2012, the sites on ULNA farm holdings appear in excellent condition and the aggressive weed management/crop harvest schedule implemented previously appear to be keeping weed populations at bay except as the season matures and the fescue enters dormancy. The Bermudagrass and fescue grass crops have been harvested in a timely manner and the dust was applied to receiver sites as weather and agricultural operations permitted. The pines established on site 6 and the mixed growth regenerating on site 4 appear to be growing well.

Total dust production reported for the 2011-2012 processing season was approximately 2600 tons and 100% applied to permitted land at ULNA. The loading rates to field sites ranged between 3.25 and a maximum of 6.5 tons/acre.

The dust loading rate to ULNA sites utilized in the 2011-2012 processing season averaged less than 6.5 tons/acre. This loading rate is significantly less than that utilized previously because of the reduced leaf production and improved recovery of product through improved in-plant processing

The land application program implemented as a management option to handle the tobacco dust generated at the ULNA Facility continues to operate well. One of the conditions of the operating permit requires periodic sampling of the dust generated at the facility to determine the levels of nutrients and other constituents that impact potential for beneficial reuse of the dust and a second element of the permit requires an assessment of the site, soil and vegetation on the sites receiving dust. These permit conditions were followed and these tests are intended as routine annual testing and associated reporting. The sites will continue to serve as the foundation for the beneficial use effort conducted by ULNA. Three elements of the operation were examined. These are:

1. The nutrient, lime and regulated metal content of the dust
2. Soil test results using standard agricultural test parameters
3. Vegetation quality and yield

In addition, a visual assessment of the fields, the application equipment operation, and site management practices were observed during the dust sampling events and soil/plant testing. These program elements and observations are the subject of the report which follows. The dust testing was accomplished monthly while the plant and soil was tested once during the year in the summer following the conclusion of annual application operations.

Tobacco Dust Testing:

The tobacco dust testing was accomplished on a frequent basis to assess seasonal differences in the quality of the dust applied to the agricultural and silvicultural sites. A composite sample of the dust was collected from the dust storage areas on the ULNA farm. The dust was subjected to a battery of standard analytic procedures as accomplished by NCDA, Agronomic Services to determine levels of nutrients, lime equivalency, and the concentrations of selected metals and visually to assess the level of leaf, stem, and dust in the material..

Results from these dust sampling events are presented in Table 1, Tobacco Dust Quality, ULNA Facility, below. Testing was accomplished in accordance with the North Carolina Department Agriculture, Agronomic Services Section

Table 1, Tobacco Dust Quality, ULNA Facility (as % for nutrients, Carbon and Calcium carbonate Equivalence and PPM for regulated metals), 2010-2011 Monthly Values

	N	P	K	Ca	Mg	Na	C	Cu	Zn	Ni	Pb	Cd	CCE
S	1.64	0.17	1.83	1.98	0.4	0.01	18.7	9.87	58.1	2.12	2.8	0.25	8.2
O	2.19	0.21	1.52	3.32	0.42	0.01	23.3	9.01	49.3	5.76	4.2	0.34	7.4
N	2.18	0.22	2.65	2.95	0.43	0.01	2..17	8.13	45.2	6.18	3.8	0.32	4.8
D	2.34	0.25	2.84	3.19	0.46	0.01	23.3	9.12	47.4	8.21	3.9	0.32	6.2
J	2.28	0.24	2.67	3.15	0.45	0.01	22.7	8.75	46.0	7.43	3.7	0.31	6.5
F	1.59	0.16	2.67	1.58	0.44	0.02	21.3	13.1	70.2	8.39	2.8	1.0	6.3
M	3.79	0.30	1.98	2.98	0.52	0.02	32.0	13.6	56.7	6.09	4.0	1.0	5.1
A	2.54	0.22	2.69	2.61	0.35	0.01	22.0	8.25	43.1	9.77	5.2	1.1	6.0
M	2.17	0.24	2.52	2.99	0.39	0.01	18.9	8.43	45.8	7.2	2.9	1.3	7.1
AVE	**2.3**	**0.22**	**2.37**	**2.75**	**0.43**	**0.01**	**22.7**	**9.91**	**51.5**	**6.8**	**3.7**	**0.66**	**6.4**

Detection level for Ni, Pb and Cd are 2.5, 2.5 and 0.25 respectively

Tobacco dust quality indicates that the material is a low analysis fertilizer. The potassium (K) levels are particularly valuable for crop production. Potassium is the limiting annual constituent in this material. The typical potassium level per ton of product ranges between 32 and 57 pounds. Potassium can be consumed through luxury uptake at levels of 250 to 300 pounds per acre in the Bermudagrass provided other essential nutrients are available. This is equivalent to approximately 6.5 tons per acre loading of the dust and during this processing season no site received more than the 6.5 tons as justified by crop yields discussed below. The analysis does indicate valuable levels of nitrogen (averaging approximately 50 pounds per ton) and phosphorus (averaging approximately 5 pounds per ton) are present in the leaf waste. These values represent a total concentration and only a portion of this is plant available. The available nitrogen (plant available nitrogen or PAN) is typically 40% of the Total Nitrogen (TN) and available P is typically 40 to 50% or biologically bound phosphorus. The levels of nitrogen and phosphorus are sub-optimum to support luxury consumption of the potassium. Supplemental N and P would be required to maximize potential uptake of K.

ULNA requested analysis of organic carbon in the tobacco dust. That testing was accomplished and is reported as "C" in the table.

The dust contains moderate levels of calcium (Ca) and magnesium (Mg), with low levels of associated sodium (Na). These elements combine to determine the sodium adsorption ratio (SAR) of a waste stream. The SAR of the tobacco dust is well below 10 units and an SAR of 10 or greater may be an issue in agriculture. The SAR is of no consequence in this operation. The moderate level of lime as indicated by the calcium carbonate Equivalence (CCE) suggests that loadings should be limited to no more than 8 to 10 tons per acre for the composite 2011-2012 or the equivalent of approximately 0.8 ton of lime per acre. Actual loads were below this confirming that CCE is not the limiting constituent. High loadings of the dust may result in an unhealthy increase in soil pH and adverse impacts

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1 (deleting entire closed land app site)

on crop quality; no adverse impact was observed in plant tissue testing presented subsequently.

The testing indicates low levels of regulated metals (Cd, Cu. Ni, Pb, and Zn). Levels reported are below limits established in NCDWM Regulations. The January – February through May metal level tests do show some increase over typical levels. No explanation is necessary because the levels are still well below regulatory limits. Based on the analysis the levels of these regulated metals in the dust are well below the regulatory levels established in NCDWM Rule for cumulative limits in land applied materials. Based on the levels detected, no cumulative loading limits apply to the receiver site fields. Regulated metal concentrations should have no adverse impact on the continued land application effort and should have no adverse impact to compost produced at commercial facilities in the area.

Soil Testing:

Representative samples of the soil material from each of the sites receiving dust from the ULNA facility in Nashville, NC were collected in a manner utilized in recent years to assess soil quality. Historically the soil samples were collected by simply removing vegetation from the soil surface and advancing a soil probe to collect the sample. During these recent sampling periods the "O" horizon was scratched away to eliminate dust and collect only soil. This was accomplished because previous sampling efforts show the levels of potassium and phosphorus as trending upward – but not to levels considered a hazard to crop production.

In samples collected to represent the 2011-2012 processing season, P and K levels in soil materials were observed to stabilize. These samples were collected by removing the decaying vegetation and organic matter which accumulates on the soil surface and then advancing a soil core into the bare soil more representative of an "A" horizon and less typical of an "O" horizon..

Approximately 20 to 25 small, 1 inch diameter cores from the soil surface to between approximately 4 and 6 inches below the surface were collected and representative composites were developed from each of the fields or land management units. These were subjected to a battery of standard soil fertility tests as accomplished by North Carolina Department of Agriculture, Agronomic Services. Results from the annual sampling are summarized in Table 2, Soil Quality ULNA Receiver Sites, Nashville, NC, 2011-2012 Processing Season, below.

The concentrations of constituents detected were converted to index values as used by the NCDA in standard soil tests. The index units for P and K are high. Any index over 100 suggests the constituent is present at a level in excess of a crops immediate need. Field 3 was the last field enrolled in the land treatment program and it does show moderately low levels for parameters tested. The P and K values are elevated. The sample designated with a "C" were collected as "control" samples adjacent to the field, but in a buffer zone and outside the actual application area.

In addition, the soil pH is elevated on several of the permitted receiver sites. The CCE and Calcium levels in the dust are responsible for these elevated soil pH values. Optimum soil pH for fescue grass is between 6.2 and 6.5 standard pH units. Measured soil pH values in excess of 7.5 may require addition of sulfur at some time to depress soil pH. Soil pH is important because of the influence on nutrient uptake.

Table 2, UNLA Soil Test Results from Dust Receiver Sites and Check Receiving no Dust, 2011-2012 Processing Season (values as standard NCDA test results)

Parameter	1	2	3	4	5	6	7	8	Check
OM	.22	.32	.13	.36	.66	.27	.22	.34	.32
pH	7.5	7.4	7.0	7.5	6.7	6.5	6.8	6.5	6.3
CEC Meq	15.3	15.8	13.5	11.8	7.8	6.6	12.2	11.6	10.6
P (I)	179	294	63	174	265	96	118	129	59
K (I)	253	424	160	182	188	176	112	152	115
Ca (%)	71	69	69	79	76	67	71	76	74
Mg (%)	21	17	23	13	12	17	21	18	15
Na (%)	.1	.1	.1	.1	.1	.1	.1	.1	.1
Zn (I)	270	332	136	248	152	100	243	181	143
Cu (I)	479	378	154	297	246	199	397	201	141

Results as NCDA index or % CEC – an index over 100 suggests availability, an index over 400 suggests an excess of the nutrient,

The levels of copper and zinc in the soil materials tested are beginning to show signs of moderate accumulation, but well below regulatory levels established in rule (40 CFR Part 503 or NCDWM). These regulated metals are not present in the soil anywhere near the regulatory limits imposed by USEPA, but sensitive crops such as peanuts may be difficult to produce on the sites with elevated copper and zinc. An elevated copper or zinc level is any level over 100 units and while some fields show these levels, there is no imminent hazard to the plant – soil system or to surface and groundwater in the area.

Plant Tissue Testing:

Plant materials serve as indicators of the biological integrity of a land based treatment system. Plant materials serve as the ultimate host for the materials applied to a site. Samples of vegetation were collected near each of the 20 to 25 locations in the receiver sites where a soil sample was collected. A control sample of the Coastal Bermudagrass vegetation was collected from an area near the entrance road on the western - most portion of the ULNA site (Field 2). The plant samples were placed in paper bags when collected. Plant tissue was subjected to a battery of standard tests as accomplished by the

North Carolina Department of Agriculture. The results from the plant tissue testing are presented in Table 3, below.

The elevated levels of nitrate (NO3) in several of the samples may be cause for caution. Feeding forage with elevated nitrate levels to young or lactating cattle may cause problems. Where nitrate levels in forage exceed 2500 PPM, the grazing operations should be monitored or forage with low nitrate could be mixed and blended with the high nitrate forage. One of the Fescue grass forage samples showed a nitrate level near the 2500 PPM (0.25%) level for concern, nonetheless, continued nitrate testing should be accomplished routinely.

The samples of warm season forage grasses were collected in June, the typical growing season and this time is least favorable for these cool season grasses. Consequently, the cool season grass field was sampled in April to assure more relevant sample data. The Bermudagrass/Rye is most prevalent on fields 2, 3, 4, 5 and 7. Fescue is most prevalent on fields 1 and 6. Plant tissue samples were collected from the newer bales on the Bermudagrass fields and from the pasture on the Fescue sites. Neither the baled forage nor the pasture show high nitrate levels. Forage samples should continue to be collected as a routine part of the land application operation to assure forage quality does not pose hazard to animals feeding on the bales.

In addition to the forage testing, the weed control program implemented during this processing season must be continued annually to prevent accumulation of the weedy vegetation on fields. The material applied to the fields is from fields throughout the leaf growing area. Weed seed is a common contaminant in the land applied soil materials. At the time of the sampling, weed growth was responsible for a very slight and insignificant percentage of plant materials present on the fields 1,2,3,4 and 7. Weed growth was significant on fields 5 and 6. Weed seed is present in the dust applied and aggressive weed control measures remain a necessity to prevent growth of noxious vegetation which may be deleterious to animals consuming the hay.

Cool season forage (fescue grass) should be tested in the spring and again in the fall. Fescue was not the predominant grass on the site. The warm season Bermudagrass crop was planted on most of the fields in 2009 and this crop has done well and is replacing the Fescue initially planted. This warm season grass is very well suited for this activity and it should be tested in the late spring or early summer to assess nutrient levels.

Table 3, ULNA Plant Tissue Quality from Dust Receiver Sites and Check Receiving no Dust ("L" indicates a low level and "H" indicates a high level for the constituent labeled) for the 2011-2012 Season

Parameter	1 F	2 CB	3 CB	4 CB	5 CB	6 F	7 CB	Check
N %	3.28 H	2.32	2.37	2.26	2.01	3.61	2.52	1.50 L
P %	0.24	0.36	0.32	0.2 L	0.26	0.21 L	0.35	0.2 L
K %	2.66	3.70	2.83	2.51	2.31	2.68	2.12	2.0 L
Zn PPM	56.1	46.5	37.9	26.7	33.4	51.8	48.2	31.0
Cu PPM	11.2	10.9	10.2	9.7	10	9.3	9.4	7.52
NO3 %	0.19	0.12	0.15	0.16	0.16	0.22	0.15	0.11

Vegetation raised on the permitted receiver sites serves as the indicator of the biological integrity of the land treatment system. Continued testing of the plant material is important to the long term operation of this or any other land treatment system.

Typical removal efficiencies resulted in harvests of between 8 and 10 tons per acre during the 2011 – 2012 harvest season. These high crop removals resulted in the transport of nutrients off site to Rose Hill Farms where the hay was fed to cattle. Based on the low yield of 8 tons per acre per year, the nutrient removals are summarized in Table 4, Nutrient Removal as Pounds per Acre, ULNA Facility for the 2011-2012 growing season, below.

Table 4; Average Nutrient Removal Through Harvest as Pounds Nutrient per Acre, ULNA Facility for the 2011-2012 Processing Season

	1	2	3	4	5	6	7	Control
N	525	375	380	362	320	576	400	240
P	38.5	58	51	32	41.6	32	56	32
K	432	592	453	400	370	429	340	320

Based on crop quality and typical yields, the quantity of potassium (K) removed is very significant. Typical nutrient ratios in hay crops suggest a N:K ratio of 2:1. These values suggest there is luxury uptake of potassium through the Coastal Bermudagrass and the fescue. The N:K ratios are typically lower suggesting higher ratios of potassium to nitrogen than is generally encountered in plant materials. This trend follows on the control field and this may be associated with dust entering this area as wind driven or aeolian dust. The cropping system is capable of achieving high levels of potassium removal and the removal of nitrogen could increase if the material were more balanced as a fertilizer. The costs associated with developing that balance do not seem to justify that expense unless the removal potentials for phosphorus (P) will also increase significantly and that is unlikely with this crop scenario.

Given an average dust load of 6.5 tons/acre in the 2011-2012 season and the average characteristic for the dust, loadings to the fields are summarized in Table 5, Typical Macro-Nutrient Loads ULNA Receiver Sites, Below.

Table 5, Typical Macro-Nutrient Loads ULNA Receiver Sites (as Lb/ac)

Nutrient	N	P	K
Nutrient Load	299	28.6	308

The rates of removal listed in the table above suggest the nutrient removal described in Table 4 exceeds the applications described in Table 5. This is clearly beneficial and indicates luxury consumption for both applied nutrients or constituents and those stored on the site from previous applications and mineralization of crop residue.

Conclusions:

The land application operation has served as an effective receiver for the dust generated at the Universal Leaf North America facility since opening day. Previously dust from other facilities was applied to land beneficially. Accumulation of plant nutrients can be an issue whenever the quantity applied exceeds the quantity removed. Based on the soil test results, there is some accumulation of phosphorus, potassium, zinc and copper in the shallow soil and the soil pH is generally high for a pasture operation.

Plant tissue testing and yield measures suggest luxury consumption for these crops. The levels of parameters detected in soil material and plant material demonstrate no adverse impact to the receiver environment. Potentially adverse impact can be averted and controlled by careful operation of the facility, representative sampling and testing, and aggressive harvest and removal of the receiver site crops. In addition, the management at the ULNA facility should examine opportunities to increase available land onto which these materials can be applied and continue the additional option afforded through composting to provide sustainable, long term outlets for these beneficial materials.

Respectfully Submitted;

A. R. Rubin, Professor Emeritus